REMARKS

This is a full and timely response to the outstanding non-final Office Action mailed October 23, 2002. Reconsideration and allowance of the application and presently pending claims, as amended, are respectfully requested.

1. Present Status of Patent Application

Upon entry of the amendments in this response, claims 1-21 and 23-68 remain pending in the present application. More specifically, claims 1, 12, 14-15, 21, 27, 29-30, 32, 34, 36, 43-48 and 65-68 are directly amended. These amendments are specifically described hereinafter. It is believed that the foregoing amendments add no new matter to the present application.

2. Response To Objections/Rejections

Response To Objections To Claims

Claims 14, 15, 29, 30 and 65-68 have been objected to because of informalities. As suggested by the Office, Applicants have amended claims 14, 15, 29 and 30 to replace the phrase "a thickness in the range of about 10 to about 500 angstroms" to --a thickness in the range of from about 10 to about 500 angstroms--. Accordingly, Applicants request that the objection be withdrawn.

The Office also suggested that in claims 65-68, the phrase "semiconductor layer" be amended to --the compound semiconductor layer--. Appropriate correction has been made, and Applicants request that these rejections be withdrawn as well.

Response To Claim Rejections Under 35 U.S.C. Section 112, First Paragraph

Amended claims 1, 21, 34 and 36 have been rejected under 35 U.S.C. 112, First Paragraph, as allegedly

> containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The newly added limitation "wherein additional overlayers of conductive metal are not necessary in the ohmic contact" is new matter and not described in the as-filed specification.

Office Action at 2 (emphasis omitted). Applicants respectfully traverse this rejection.

The Examiner's attention is directed to the patent application as filed at page 3, lines 24-26 in the "Summary of the Invention" section, which states "[n]o additional overlayers of conductive metal are necessary to form the contact system in accordance with a preferred embodiment of the present invention." This is nearly verbatim the phrase that was added to amended claims 1, 21, 34 and 36 in the Preliminary Amendment mailed on September 24, 2002.

Claims 1, 21, 34 and 36 have been amended herein with respect to rejections made under 35 U.S.C. Section 112, Second Paragraph, and not in response to the rejections under 35 U.S.C. Section 112, First Paragraph. In claims 1 and 36 the phrase "additional overlayers of conductive metal are not necessary in the ohmic contact" has been replaced with the phrase --additional layers of conductive metal are not deposited on the refractory layer in the ohmic contact--. Further, claims 21 and 34 each have been amended to replace the phrase "additional overlayers of conductive metal are not necessary in the ohmic contact" with the phrase --additional layers of conductive metal on the refractory layer are not necessary in the ohmic contact--. Applicants submit that the amended phrases do not constitute new matter as they are described in the as-filed specification at least in the portion of page 3 referenced above. Additional support for the claim amendments can be found at least on page 7, lines 1-12, which state in part as follows:

> The increased thickness of the refractory layer metallization improves (*i.e.*, reduces) contact sheet resistance and eliminates the need for deposition of a low-resistivity, high-conductivity gold overlayer. Prior art techniques typically include depositing a low sheet resistance gold overlayer on the contact system to reduce the sheet resistance of the contact.... Alternatively, this low sheet resistance overlayer may comprise any one or more of a variety of different metals and/or materials having such properties of low resistivity and high conductivity in the described application. For ease of discussion, "gold" will be used to represent all metals and/or materials having such desirable electrical properties.

Additionally, page 7, lines 26-27, states "[n]o overlayer metallization comprising gold or other highly conductive material, except in trace amounts, is needed." Thus, the newly amended phrases of claims 1, 21, 34 and 36 also have support in the specification, as did the amended claims submitted in the Preliminary Amendment submitted on September 24, 2002. For at least these reasons, Applicants respectfully request that the rejection under 35 U.S.C. 112, First Paragraph, be withdrawn with respect to claims 1, 21, 34 and 36.

Response To Claim Rejections Under 35 U.S.C. Section 112, Second Paragraph

Claims 1 and 36 have been rejected under 35 U.S.C. Section 112, Second Paragraph, as purportedly "being incomplete for omitting essential steps, such omission amounting to a gap between the steps.... The omitted step is forming 'additional overlayers of conductive metal.'" (Office Action at 3.) Claims 1 and 36 have been amended to replace the phrase "wherein additional overlayers of conductive metal are not necessary" with the phrase --wherein additional layers of conductive metal are not deposited--. Applicants submit that the amendment to claims 1 and 36 overcomes the rejection, and request that the rejection be withdrawn.

Claims 21, 34, 43 and 44 have been rejected under 35 U.S.C. Section 112, Second Paragraph, as allegedly "being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections." (Office Action at 3.) Claims 21 and 34 have been amended to replace the phrase "additional layers of conductive metal are not necessary" with the phrase --additional layers of conductive metal *on the refractory layer* are not necessary--. (Emphasis added.) Applicants submit that the relevant location of the "additional layers of conductive metal" have now been properly identified with respect to the region of the "refractory layer."

With respect to claims 43 and 44, these claims have been amended to incorporate the method steps of claims 1 and 36, respectively, to which they originally referred. Thus, Applicants respectfully request that the rejection of claims 43 and 44 be withdrawn as well.

Claims 1, 7, 12, 21, 27, 32, 34, 36 and 45-48 have been rejected under 35 U.S.C. 112, Second Paragraph, as purportedly "being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention." (Office Action at 3.) In particular, the Office alleges that "[t]he language 'said refractory layer is substantially free of gold' as recited in the respective claims 1, 21, 34 and 36 renders indefinite [sic] because 'substantially free of gold' does not give metes and bounds." (Office Action at 4, emphasis omitted.)

In regard to claims 1, 21, 34 and 36, the Office alleges that the term "substantially" as used in these claims renders the metes and bounds of the claims indefinite. It has been acknowledged by the Court of Appeals for the Federal Circuit that relative terms such as "substantially" do not *per se* render a claim indefinite. *See Andrew Corp. v. Gabriel Elects., Inc.*,

847 F.2d 819, 6 USPQ2d 2010 (Fed. Cir. 1988), *cert. denied*, 488 U.S. 927 (Sup. Ct. 1988). In this case, the court commented that such words are "ubiquitous in patent claims. Such usages, when serving reasonably to describe the claimed subject-matter to those of skill in the field of the invention, and to distinguish the claimed subject matter from the prior art, have been accepted in patent examination and upheld by the courts." *Id.*, 847 F.2d at 821, 6 USPQ2d at 2012. In that Applicants believe that a person having ordinary skill in the art would not find claims 1, 21, 34 and 36 ambiguous for their use of "substantially," Applicants respectfully submit that these claims are not indefinite and request that the rejection be withdrawn.

Furthermore, the Office Action claims that "the language 'additional overlayers of conductive metal are not necessary in the ohmic contact' as recited in claims 1, 21, 34 and 36 is vague...." (Office Action at 4.) As noted previously, the language of this portion of the claim has been amended, which Applicants believe overcomes the Examiner's assertion of vagueness.

Claims 1, 7 and 21 have been rejected as being indefinite. The Office suggests that the Applicants rewrite the claims in a Markush group. Applicants respectfully traverse, and direct the Office's attention to M.P.E.P. §2173.05 (h), which reads: "Alternative expressions are permitted if they present no uncertainty or ambiguity with respect to the question of scope or clarity of the claims. *One acceptable form of alternative expression...* is commonly referred to as a Markush group...." (Emphasis added.) Thus, while a Markush group is <u>one</u> acceptable expression in claim language, Applicants <u>are not limited to that exact expression, and may use alternative expressions</u> as long as the claim language and scope are certain and unambiguous. Applicants believe that an exemplary phrase "X chosen from A, B, and C" is clear and unambiguous. Applicants are not limited to the exact phrases suggested by the Examiner because the claims as they stand are clear and unambiguous. Thus, Applicants respectfully request that the rejection of claims 1, 7 and 21 be withdrawn.

Claims 12 and 27 have also been rejected, with the Office Action stating that the "alternative limitation as recited in claims 12 and 27 is also unacceptable, *i.e.* 'material selected from the group comprising titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicide [sic] and metal borides.'" (Office Action at 4, emphasis omitted.) The Office suggests that "[t]he acceptable form should be 'material selected from the group consisting of titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicide [sic] and metal borides.'" (Office

Action at 4-5, emphasis omitted.) The suggested claim amendments have been made, and Applicants respectfully submit that they have overcome the rejection of claims 12 and 27.

Further, the Office Action states that

> [t]he limitations "the ohmic contact can be used in a laser diode, a light emitting diode, a Schottky, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, and a high electron mobility transistor", as recited in claims 45-48, should be changed into --the ohmic contact can be used in a laser diode, a light emitting diode, a Schottky, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, or a high electron mobility transistor--.

(Office Action at 5, emphasis omitted.) Accordingly, Applicants have amended claims 47 and 48 as suggested by the Office Action. Applicants have amended claims 45 and 46 to read as follows: "the ohmic contact can be used in *at least one of* a laser diode, ..." (Emphasis added.) Applicants believe that the amendments to claims 45 and 46 also overcome the rejection and respectfully request that it be withdrawn.

With respect to claim 32, the Office Action states that "[t]he limitation 'a thickness of at least about 100 angstroms' as recited in claim 32 renders indefinite [sic] because the phrase 'at least' had no upper limit." (Office Action at 5.) Claim 32 has been amended to delete the phrase "at least", and therefore Applicants respectfully request that this rejection be withdrawn.

Applicants wish to clarify that the foregoing amendments are cosmetic in nature and are not made as a condition for obtaining a patent. Applicant further submits that these amendments are non-narrowing and, pursuant to *Festo Corp. v. Shoketsu Kinzoku Kogyo Kabushiki Co.*, 122 S. Ct. 1831 (2002), no prosecution history estoppel arises from these amendments.

Response To Claim Rejections Under 35 U.S.C. Section 102

Claims 1, 2, 7-9, 12-13, 19-21, 23-25, 27-28, 34, 36, 43-48 and 61-64 have been rejected under 35 U.S.C. §102(b) as allegedly anticipated by *Yanagihara et al.* Independent claims 1 and 36 each have been amended to recite "additional layers of conductive metal are not deposited on the refractory layer in the ohmic contact." Further, claims 21 and 34 each have been amended to recite "additional layers of conductive metal on the refractory layer are not necessary in the ohmic contact."

The independent claims are allowable for at least the reason that *Yanagihara et al.* do not disclose, teach, or suggest these features, as well as other aspects of the independent claims. As noted previously in the "Response to Claim Rejections Under 35 U.S.C. Section 112, First Paragraph" section of this Response, this amendment does *not* constitute new matter.

The ohmic contact of *Yanagihara et al.* includes a titanium and/or platinum overlayer. *See* column 5, lines 36-41 and column 6, lines 20-22 and FIGS. 2B and 2D. The present application, in contrast, has claimed a refractory layer that

> improves (*i.e.*, reduces) contact sheet resistance and eliminates the need for deposition of a low-resistivity, high-conductivity gold overlayer. Prior art techniques typically include depositing a low sheet resistance gold overlayer on the contact system to reduce the sheet resistance of the contact. ... Alternatively, this low sheet resistance overlayer may comprise any one or more of a variety of different metals and/or material having such properties of low-resistivity and high-conductivity in the described application. For ease of discussion, "gold" will be used to represent all metals and/or materials having such desirable electrical properties.

See instant specification, page 7, lines 1-11.

The present application has eliminated the need for the titanium, platinum, gold or other highly conductive material as an overlayer metallization that is present in the device of *Yanagihara et al.* Thus, as discussed in the present specification, processing time may be shortened by reducing the number of metallization layers in the contact structure, and material cost may be reduced by eliminating and/or minimizing the use of precious metals. (*See* specification, page 9, lines 21-30). The benefits of embodiments of the present invention are accomplished without sacrificing device performance or functionality. For at least these reasons, the ohmic contact of *Yanagihara et al.* does not anticipate independent claims 1, 21, 34 and 36.

Because independent claims 1, 21, 34 and 36 are allowable over the prior art of record, then their dependent claims 2, 7-9, 12-13, 19-20, 23-25, 27-28, 43-48 and 61-64 are also allowable as a matter of law, because these dependent claims contain all features/elements/steps of their respective independent claims. *In re Fine*, 5 USPQ2d 1596, 1600 (Fed. Cir. 1988).

Additionally and not withstanding the forgoing reasons for the allowability of the independent claims, these dependent claims recite further features/steps and/or combinations of features/steps that are patentably distinct from the prior art of record. Hence, there are other reasons why these dependent claims are allowable. For example, the ohmic contact of

Yanagihara et al. is formed on a P+ GaAs semiconductor layer. In contrast, claims 2-6 and 37-41 claim other types of compound semiconductor layers on which the ohmic contact of the present invention is formed. Additionally, newly added claims 65-68 recite that the ohmic contact of the present invention is formed on a N+ InGaAs compound semiconductor layer. Thus, the semiconductor device of *Yanagihara et al.* does not anticipate at least these dependent claims. Applicants respectfully request, therefore, that the rejection of all claims 1, 2, 7-9, 12-13, 19-21, 23-25, 27-28, 34, 36, 43-48 and 61-64 be withdrawn.

Response To Claim Rejections Under 35 U.S.C. Section 103

Claims 3-5, 10, 11, 37-40 and 65-68 stand rejected under 35 U.S.C. §103(a) as allegedly unpatentable over *Yanagihara et al.* in view of *Yagura et al.* (U.S. Patent No. 6,188,137). Each of these claims are dependent upon independent claims 1, 21, 34 and 36, respectively, and therefore contain all the limitations/features of those claims. As noted above, the independent claims are allowable over the prior art of record, and thus these dependent claims are allowable, for at least this reason. *In re Fine, supra* Applicants therefore respectfully request that the rejections of these dependent claims be withdrawn.

Claims 6, 14-18, 26, 29-33, 35, 41 and 42 have been rejected under 35 U.S.C. §103(a) as purportedly being unpatentable over *Yanagihara et al.* in view of *Uchibori et al.* (U.S. Patent No. 5,982,036). Each of these claims are dependent upon independent claims 1, 21, 34 and 36, respectively, and therefore contain all the features of those claims. Because the independent claims are allowable over the prior art of record, these dependent claims are allowable, for at least this reason. *In re Fine, supra.* Applicants therefore respectfully request that the rejections of these claims be withdrawn.

Claim 11 has been rejected under 35 U.S.C. §103(A) as purportedly being unpatentable over *Yanagihara et al.* in view of *Yagura et al.*, and further in view of *Uchibori et al.* Claim 11 depends from claim 4 which depends from independent claim 1. As noted above, independent claim 1 is allowable, and therefore dependent claim 11 is also allowable for at least this reason.

Claims 49-60 have been rejected under 35 U.S.C. §103(a) as being allegedly unpatentable over *Yanagihara et al.* and *Yagura et al.*, and further in view of *Bernhardt et al.* (U.S. Patent No.

5,583,355). As noted above, these dependent claims are dependent upon allowable independent claims. For at least this reason, Applicants respectfully request that the rejection be withdrawn.

3. Prior Art Made of Record

The prior art newly made of record has been considered, but is not believed to affect the patentability of the presently pending claims.

CONCLUSION

In light of the foregoing amendments and for at least the reasons set forth above, Applicants respectfully submit that all objections and/or rejections have been traversed and/or accommodated, and that the now pending claims 1-21 and 23-68 are in condition for allowance. Favorable reconsideration and allowance of the present application and all pending claims are hereby courteously requested. If, in the opinion of the Examiner, a telephone conference would expedite the examination of this matter, the Examiner is invited to call the undersigned attorney at (770) 933-9500.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the United States Postal Service as first class mail, postage prepaid, in an envelope addressed to: Commissioner for Patents, Washington D.C. 20231, on 12/30/02

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ANNOTATED VERSION OF MODIFIED CLAIMS TO SHOW CHANGES MADE

The following is a marked up version of the amended claims. Amend the following claims by adding the language that is underlined ("___") and by deleting the language that is enclosed within brackets ("[ ]"):

1. (Thrice Amended) A method for forming an ohmic contact on a semiconductor layer comprising:

(a) depositing a reactive layer comprising at least one electrically conductive material on at least a portion of a compound semiconductor layer, wherein the at least one electrically conductive material is chosen from nickel, ruthenium, vanadium, gold, and cobalt; and

(b) depositing a refractory layer comprising electrically conductive material on the reactive layer, wherein said refractory layer is substantially free of gold, and

wherein additional [overlayers] layers of conductive metal are not [necessary] deposited on the refractory layer in the forming of the ohmic contact.

12. (Once Amended) The method according to claim 1 wherein said step of depositing a refractory layer on the reactive layer comprises depositing a refractory layer comprising material selected from the group [comprising] consisting of: titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicides and metal borides.

14. (Once Amended) The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer having a thickness in the range of from about 10 to about 500 angstroms.

15. (Once Amended) The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer having a thickness in the range of from about 20 to about 100 angstroms.

21. (Thrice Amended) An ohmic contact to a compound semiconductor layer comprising:

(a) a reactive layer comprising at least one electrically conductive material, wherein the at least one electrically conductive material is chosen from nickel, ruthenium, vanadium, gold, and cobalt, and

(b) a refractory layer, wherein said refractory layer is substantially free of gold, and

wherein additional [overlayers] layers of conductive metal on the refractory layer are not necessary in the ohmic contact.

27. (Once Amended) The ohmic contact according to claim 21 wherein said refractory layer comprises a material selected from the group [comprising] consisting of: titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicides and metal borides.

29. (Once Amended) The ohmic contact according to claim 1 wherein said reactive layer has a thickness in the range of from about 10 to about 500 angstroms.

30. (Once Amended) The ohmic contact according to claim 1 wherein said reactive layer has a thickness in the range of from about 20 to about 100 angstroms.

32. (Once Amended) The ohmic contact according to claim 21 wherein said refractory layer has a thickness of [at least] about 100 angstroms.

34. (Thrice Amended) An ohmic contact to a compound semiconductor layer comprising:

(a) a reactive layer, said reactive layer is nickel; and

(b) a refractory layer, said refractory layer is titanium,

wherein said refractory layer is substantially free of gold, and

wherein additional [overlayers] layers of conductive metal on the refractory layer are not necessary in the ohmic contact.

36. (Thrice Amended) A method for forming an ohmic contact on a compound semiconductor layer of a semiconductor device comprising:

(a) depositing a reactive layer on at least a portion of a compound semiconductor layer of a semiconductor device, wherein the reactive layer is nickel and an adhesive element;

(b) depositing a refractory layer on said reactive layer, said refractory layer is titanium, wherein said refractory layer is substantially free of gold, and

wherein additional [overlayers] layers of conductive metal are not [necessary] deposited on the refractory layer in the forming of the ohmic contact.

43. (Once Amended) An ohmic contact to a compound semiconductor layer of a semiconductor device made by [the] a method [of claim 1] comprising:

(a) depositing a reactive layer comprising at least one electrically conductive material on at least a portion of a compound semiconductor layer, wherein the at least one electrically conductive material is chosen from nickel, ruthenium, vanadium, gold, and cobalt; and

(b) depositing a refractory layer comprising electrically conductive material on the reactive layer, wherein said refractory layer is substantially free of gold, and

wherein additional layers of conductive metal are not deposited on the refractory layer in the forming of the ohmic contact.

44. (Once Amended) An ohmic contact to a compound semiconductor layer of a semiconductor device made by [the] a method [of claim 36] comprising:

(a) depositing a reactive layer on at least a portion of a compound semiconductor layer of a semiconductor device, wherein the reactive layer is nickel and an adhesive element;

(b) depositing a refractory layer on said reactive layer, said refractory layer is titanium, wherein said refractory layer is substantially free of gold, and

wherein additional layers of conductive metal are not deposited on the refractory layer in the forming of the ohmic contact.

45. (Once Amended) The ohmic contact of claim 21, wherein the ohmic contact can be used in at least one of a laser diode, a light emitting diode, a Schottky diode, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, and a high electron mobility transistor.

46. (Once Amended) The ohmic contact of claim 34, wherein the ohmic contact can be used in at least one of a laser diode, a light emitting diode, a Schottky diode, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, and a high electron mobility transistor.

47. (Once Amended) The ohmic contact of claim 43, wherein the semiconductor device comprises a laser diode, a light emitting diode, a Schottky diode, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, [and] or a high electron mobility transistor.

48. (Once Amended) The ohmic contact of claim 44, wherein the semiconductor device comprises a laser diode, a light emitting diode, a Schottky diode, a field effect transistor, a metal-semiconductor field effect transistor, a metal-oxide-semiconductor field effect transistor, [and] or a high electron mobility transistor.

65. (Once Amended) The method of claim 1, wherein the compound semiconductor layer is N+ InGaAs.

66. (Once Amended) The method of claim 21, wherein the compound semiconductor layer is N+ InGaAs.

67. (Once Amended) The method of claim 34, wherein the compound semiconductor layer is N+ InGaAs.

68. (Once Amended) The method of claim 36, wherein the compound semiconductor layer is N+ InGaAs.